

(12) **UK Patent Application** (19) **GB** (11) **2 202 729** (13) **A**  
(43) Application published 5 Oct 1988

(21) Application No 8729513

(22) Date of filing 18 Dec 1987

(30) Priority data  
(31) 8630459 (32) 19 Dec 1986 (33) GB

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(51) INT CL<sup>4</sup>  
A42B 3/00

(52) Domestic classification (Edition J):  
A3V 11D 12M

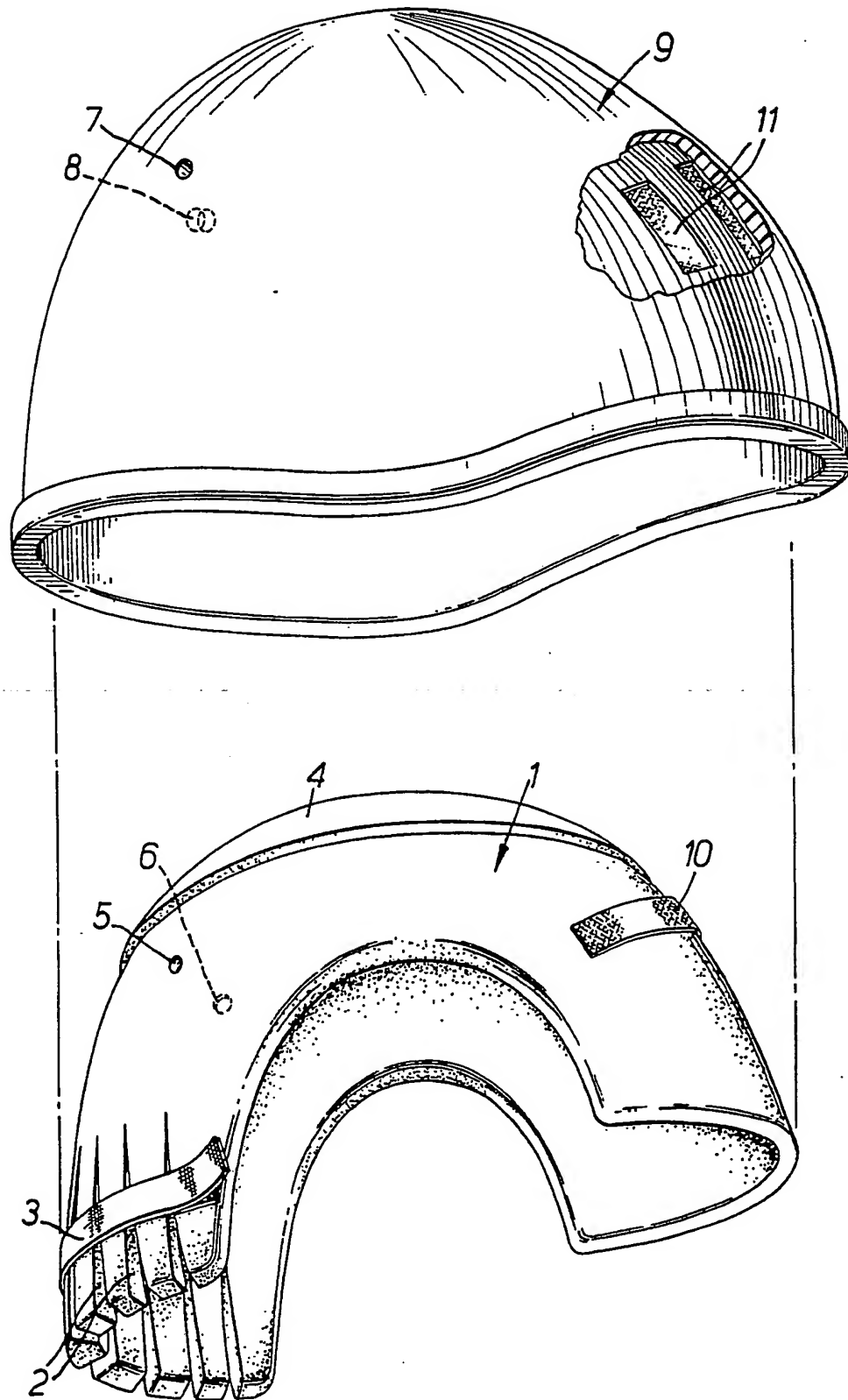
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(58) Field of search  
A3V  
Selected US specifications from IPC sub-class  
A42B

(54) **Impact protection helmet**

(57) A protective helmet provided with an expanded foam lining that recovers its shape after impact. The foam is expanded high density polyethylene and the helmet shell into which it is incorporated may be constructed from ABS, polycarbonate, glass fibre-reinforced plastic, or an aramid laminate. In the latter case, the helmet offers specific ballistic protection in addition to the primary impact protection. The lining is both replaceable and adjustable to suit different size heads.

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*Fig. 1.*

IMPACT PROTECTION HELMET

The present invention relates to impact protection helmets.

Helmets are required to protect the head against impact in a variety of different situations; motorcycle riding, horse-racing, and mountaineering are just a few examples. In each case the head is separated from direct contact with the external shell of the helmet by an inner lining which serves to absorb much of the force of the impact. A preferred material for this lining is an expanded polystyrene foam; this can be moulded to fit the shape of the wearer's head and, by virtue of the numerous small cells of air that its structure contains, it exhibits effective shock absorption properties.

Expanded polystyrene has the disadvantage, however, of crushing upon impact and hence rendering the helmet unsafe for re-use. The safety of such a helmet therefore depends upon the wearer replacing it when necessary, which is both inconvenient and expensive. Furthermore it needs to be fairly thick to absorb the impact energy. This means the helmets must be large and cumbersome. It is an established requirement to reduce helmet size and to make helmets cover a wider range of wearers heads. According to the present invention, an impact protection helmet has an outer shell formed from ABS, polycarbonate or glass reinforced plastic, and a replaceable insert being formed from expanded high density polyethylene and being adjustable in shape to accommodate different sizes of head.

The high density polyethylene (HDPE) (which is recoverable in that it recovers its shape after impact) enables the helmet to provide a consistent degree of protection to the wearer regardless of whether or not it had previously suffered impact. In a particularly preferred embodiment of the invention, the HDPE used has a slightly crosslinked structure.

The use of HDPE enables the insert to be thinner than inserts of say polystyrene foam. Thus smaller, cheaper, and more importantly, less cumbersome helmets can be employed for the same degree of protection. The HDPE is much more flexible and bendy than other expanded foam linings and thus is more adjustable within the shell.

Being adjustable in shape means a single size of insert can be employed to suit many different sizes of head. Whereas before, different size inserts or helmets had to be employed, this invention enables a single size of (smaller) helmet shell to be used to cover a wide range of head sizes, the variations being taken up by the shape adjustable nature of the insert. The HDPE insert is generally of uniform thickness to offer the minimum protection over the head area. For smaller heads or greater impact protection additional layers of the HDPE can be used. In particular, additional layers over the top of the head area may be applied.

The insert may be provided with a number of slits in its perimeter which allow its shape to be expanded or reduced to suit the wearer's head size. Most conveniently the slits may be situated on the perimeter in the neck area, although other points of the perimeter would also suffice. An adjustable strap is then provided across the slits to retain the insert in the shape found most accommodating.

One embodiment of invention will now be briefly described by way of example only and with reference to the accompanying drawing in which:

Figure 1 shows a perspective view of the adjustable insert in proximity to the helmet shell.

The insert (1) is made from a single moulding of HDPE as is of generally uniform thickness. At the perimeter of the insert near the neck of the wearer, a number of slits (2) are provided to allow the flexible insert to be expanded or contracted to suit the wearer's head size. A strap (3) is used to retain the insert (1) in the desired shape. The strap may be fixed in position by a buckle means with other straps used in assembling the helmet or by the use of VELCRO. An additional layer (4) of HDPE may be provided on top of the insert. A pair of holes (5,6) in the crown of the insert (1) match a pair of holes (7,8) in the crown of the helmet shell (9) self plugging rivets through the holes (5,6) and (7,8) are used to lock the helmet shell (9) and the insert (1) together. Another point of anchorage is needed to prevent the insert and shell moving relative

to each other. To allow for (possibly) different sizes of insert and for inserts adjusted to different size heads the front anchor point is provided by VELCRO strips (10,11) mounted as shown in figure 1 such that the horizontal strip (10) on the insert (1) always engages  
5 the vertical strips (11) on the shell (9).

Straps for retaining the helmet on the head and additional soft padding or cushioning for comfort may then be employed to suit the use for which the helmet is intended.

A helmet comprising an outer shell (1) formed from acrylonitrile  
10 butadiene styrene (ABS), polycarbonate or glass fibre reinforced plastic and this novel HDPE adjustable insert (1) is particularly suitable for use as a motorcycle safety helmet, though probably in thicker layers than is needed for other protective uses.

ABS is the preferred material for the shell, offering the best  
15 results, followed by polycarbonate and then glass fibre reinforced plastic.

A degree of ballistic protection, for example against flying fragments, bullets or shrapnel can be achieved if the helmet has the novel lining used in conjunction with an outer shell constructed from  
20 an aramid (aromatic amide) laminate. In a preferred embodiment, a laminate comprising between 23 and 25 layers of Kevlar, and with a thickness of 5 to 7 mm, is used for the shell.

The present invention further provides a protective helmet with additional outer protection against bullets, wherein the impact  
25 protection helmet as hereinbefore described is provided with one or more layers of woven aramid yarn on its exterior. This woven material yields such that the individual yarns break when subjected to the force of a bullet or other fragment, thereby slowing down the latter prior to contact with the impact protection helmet shell, and  
30 hence diminishing the force suffered by the impact protection constituent of the shell.

It will be evident to those skilled in the art that the invention described will apply to other applications beyond motorcycle military and sports helmets and that whilst in some instances not all the features described will be required for operation, other applica-  
35 tions may dictate that other features well known in the art will need to be incorporated in the helmet.

## Claims

1. An impact protection helmet having an outer shell formed from ABS, polycarbonate or glass reinforced plastic, and a replaceable insert formed from expanded high density polyethylene, and being adjustable in shape to accommodate different sizes of head.
2. A helmet according to claim 1 in which the expanded polyethylene is cross-linked.
3. A helmet according to claims 1 or 2 in which the insert is provided with slits on its perimeter making the insert adjustable to accommodate different sizes of head.
4. A helmet according to claim 3 having a strap across the slits for adjusting the shape of the insert.
5. A helmet according any previous claim in which the insert is of generally uniform thickness.
6. A helmet according to claims 5 having additional layers of expanded foam at given points.
7. A helmet according to claims 4, 5 or 6 in which the insert is attached to the shell by means of a combination of fixed position retainers and adjustable attaching means.
8. A helmet according to claim 7 in which the insert is attached to the shell by means of a combination of rivet fixed position retainers and velcro strips.
9. A helmet according to any one of the preceding claims in which the outer shell includes a laminate of woven aramid yarns.
10. A helmet according to claim 9 in which the outer shell has a thickness of 5 to 7 mm and comprises 23 to 25 layers of woven aramid yarn.
11. An impact protection helmet substantially as herein described and with reference to the attached drawings.